Space Weather Technical Forecast

Issued on Saturday 18 January 2025 at 13:12 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares (R1-R2; Minor-Moderate radio blackouts) expected throughout. Chance of X-class flares (R3 - Strong radio blackouts) throughout. Decreasing Slight chance of G1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured at GOES16 was Moderate, with several M-class flares observed, mainly emanating from AR3964 and peaking here with an M7.4 at 17/1335UTC.

Eight sunspot regions cover the Earth-facing disc. AR3964 remains the most active with little overall change recently after some emergence of intermediate spots which have merged with the leading group. A Mt Wilson delta remains in this leading cluster. The largest region, AR3961 in the southeast, has shown emergence of its central spots in the past 12 hours , and an increase in penumbral area. Other regions on the disc appeared relatively stable, simple dipoles or unipoles.

No significant Earth directed Coronal Mass Ejection (CME)s were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as measured at L1 by ACE, were characterised by fast wind influence, likely to be connection to CH09/-, with the phi angle remaining mostly negative (towards the Sun) throughout. The solar wind was mainly at Elevated levels with a decline later in the period. The number of particles in the solar wind were mostly just above 10ppcc before dropping around 18/0830UTC to slightly below normal background however the data is suspect. The IMF showed Slightly Elevated highs near 11nT at first with a steady develine to Weak levels. The north-south component was at similar levels throughout between -9 and +8nT.

The net result of the above solar wind measures was Quiet to Unsettled geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background levels, despite M-class activity.

High energy electron flux (greater than 2MeV) at GOES16 was at Normal Background to Moderate levels, with a peak of 764pfu at 17/1540UTC, but with the associated 24-hour fluence remaining below the Active threshold. This figure reached 1.22e7 integrated pfu at 18/0000UTC.

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Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is Expected, with occasional M-class flares. There is a Chance of X-class flares, most likely emanating from AR3964 in the northwest, or perhaps AR3961 in the southeast.

Solar Wind / Geomagnetic Activity: No significant CMEs feature in the forecast, which comprises the ongoing effects of the current coronal hole fast wind from CH09. This gives a decreasing chance of minor geomagnetic storm G1 with Quiet to Unsettled levels most likely to persist.

Energetic Particles / Solar Radiation: GOES18 high energy proton flux carries a daily Slight Chance of S1, rising slightly with the westward advance of the most complex group and raised slightly relative to recent guidance given the increased cadence of potentially suitable flaring events.

GOES16 high energy electron flux will initially be attenuated with geomagnetic activity arising from CH09, however it then carries a likelihood of rebounding at GEO towards midweek UTC to reach Active 24-hour fluence and High diurnal peaks of flux.

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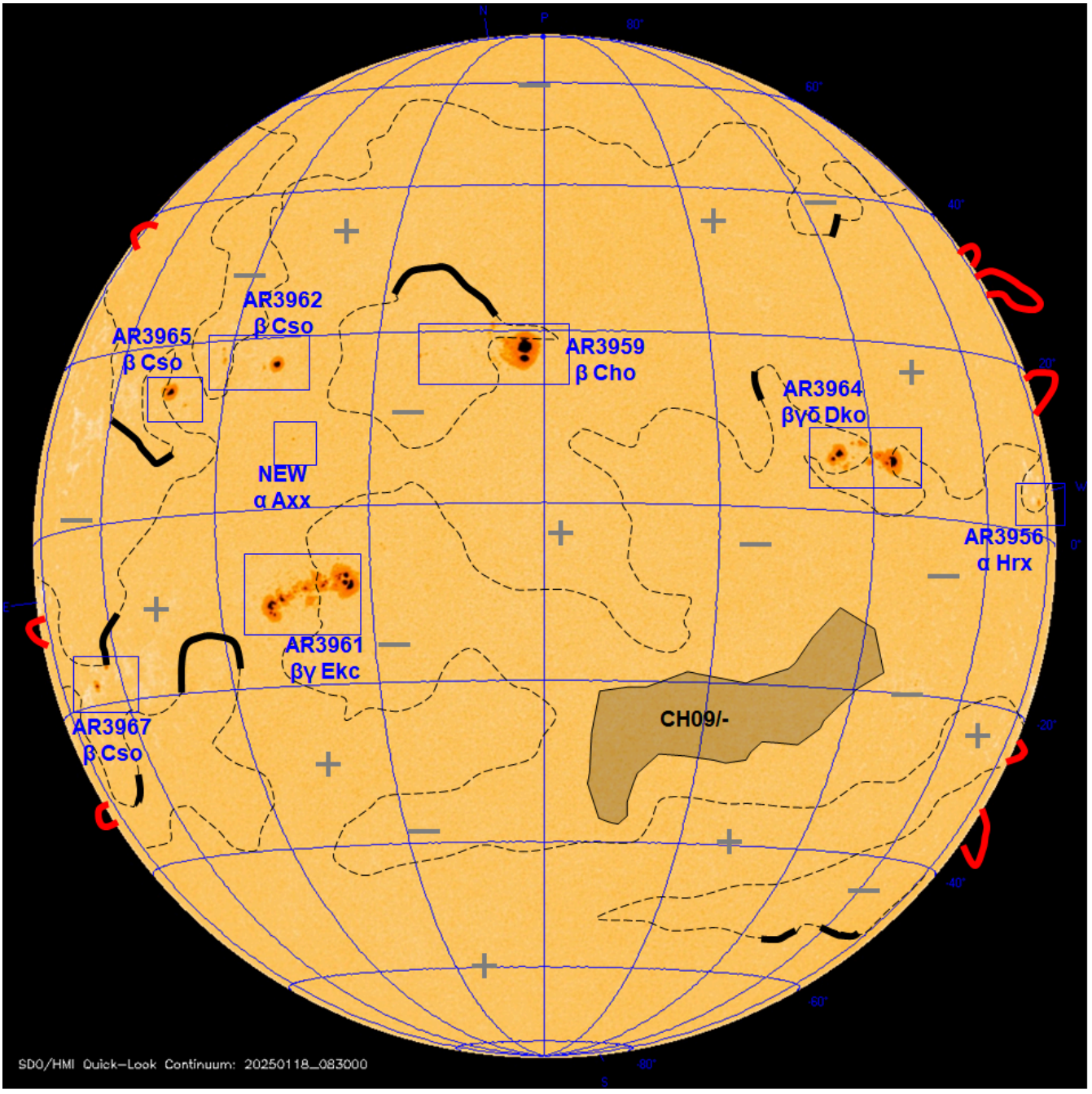
Figure 1: Solar synoptic map, valid 18/0800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No significant Earth-bound CMEs feature in the forecast.

A persistent and much-changed (compared to previous rotation) broad coronal hole across the centre of the disc, CH09/- dominates the disc. Due to the longitudinal width of this feature, fast wind influence is likely to be protracted. This feature should retreat from the solar equator with time, such that its effects should have ceased by midweek UTC at the latest, and perhaps by Tuesday 20 January. Relative to its last pass, it is wider and more intense in EUV, and there remains a chance of an isolated Minor Geomagnetic Storm G1 interval with additional consideration of being relatively further from the solstice. This ongoing enhancement is supported in MOSWOC Enlil output, although this is perhaps slightly over-estimating the longevity of the feature and the peak wind strength. There is a decreasing Chance of G1 Minor Geomagnetic Storm intervals with geomagnetic activity remaining mostly at Quiet to Unsettled levels.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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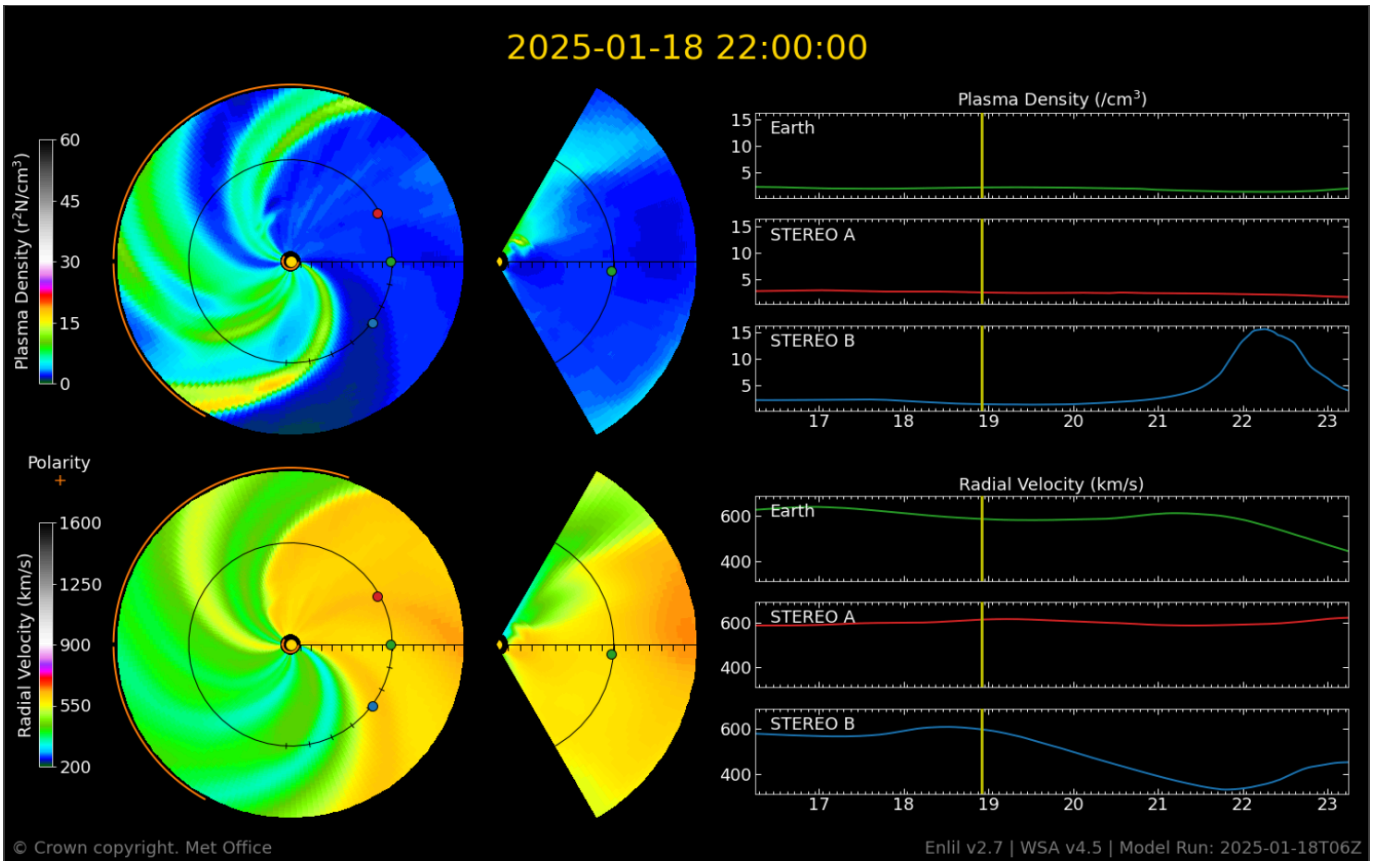
Figure 2: Latest MOSWOC Enlil run (badge time 18/0600UTC), showing a protracted contribution from CH09, perhaps overdone in terms of longevity and initial peak speed near 600km/s. No significant Earth-bound CMEs are currently in the model.



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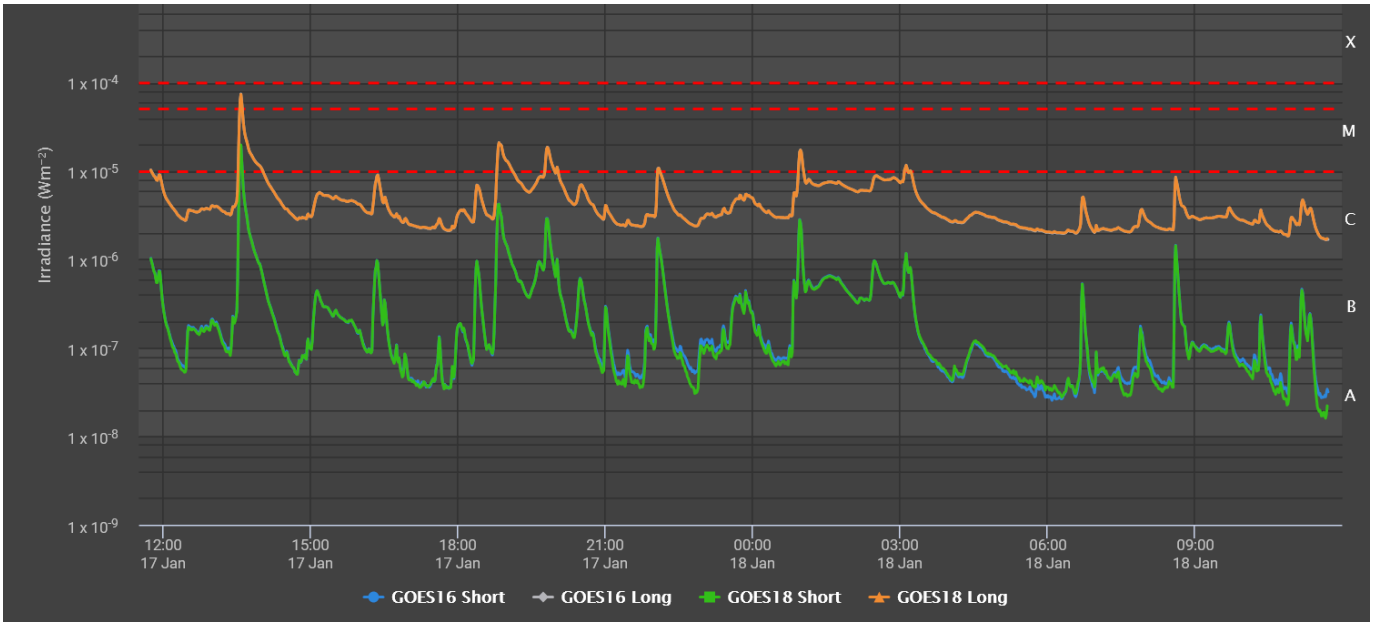
Radio Blackouts - X-Ray Flares

Solar activity has been Moderate during the last 24 hours with a number of M-Class flares from AR3964 in the northwest, peaking at M7.4 at 17/1335UTC. Further occasional M-class flares are Expected, most probably from AR3964 or AR3961. There is also a now-increased Slight Chance of an isolated X-class flare. No significant regions leave the disc in the period, with AR3964 expected to lie near the western limb by the final day of the four. As for oncoming regions, far side soundings are showing little evidence of large regions, however the returning Carrington locations for several regions lie just over the eastern solar horizon.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	70	60	60
Very Active	R3-R5 (X Class)	No	20	20	15	15

Figure 3: Latest plot of x-ray flux at GEO with several M-class flares observed.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux has remained at Background levels over the last 24 hours. The chance of S-scale events increasing in coming days as AR3964 edges westwards, with the level of risk also increased throughout given the recent growth and increased magnetic complexity of this group. Other regions are minor contributors by comparison, however AR3961 may start to play a more dominant role by the middle of the coming working week.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 is currently showing diurnal peaks within Moderate levels, although this appears to have been attenuated at GEO by geomagnetic activity arising from CH09's fast wind. The chance of Active electron fluence increases as the influence of CH09 wanes into the new week. CH09 is substantially larger and more intense in EUV imagery than on last pass, and as such MOSWOC REFM may be underplaying extent of any rebound at GEO into the new week (versus persistence of the smaller and fainted predecessor coronal hole), with a Chance of Active fluence being attained. This is hinted in recent runs, with the forecast trace running above recuurence to end the 72-hour guidance period above the Active fluence threshold.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	10	50	50
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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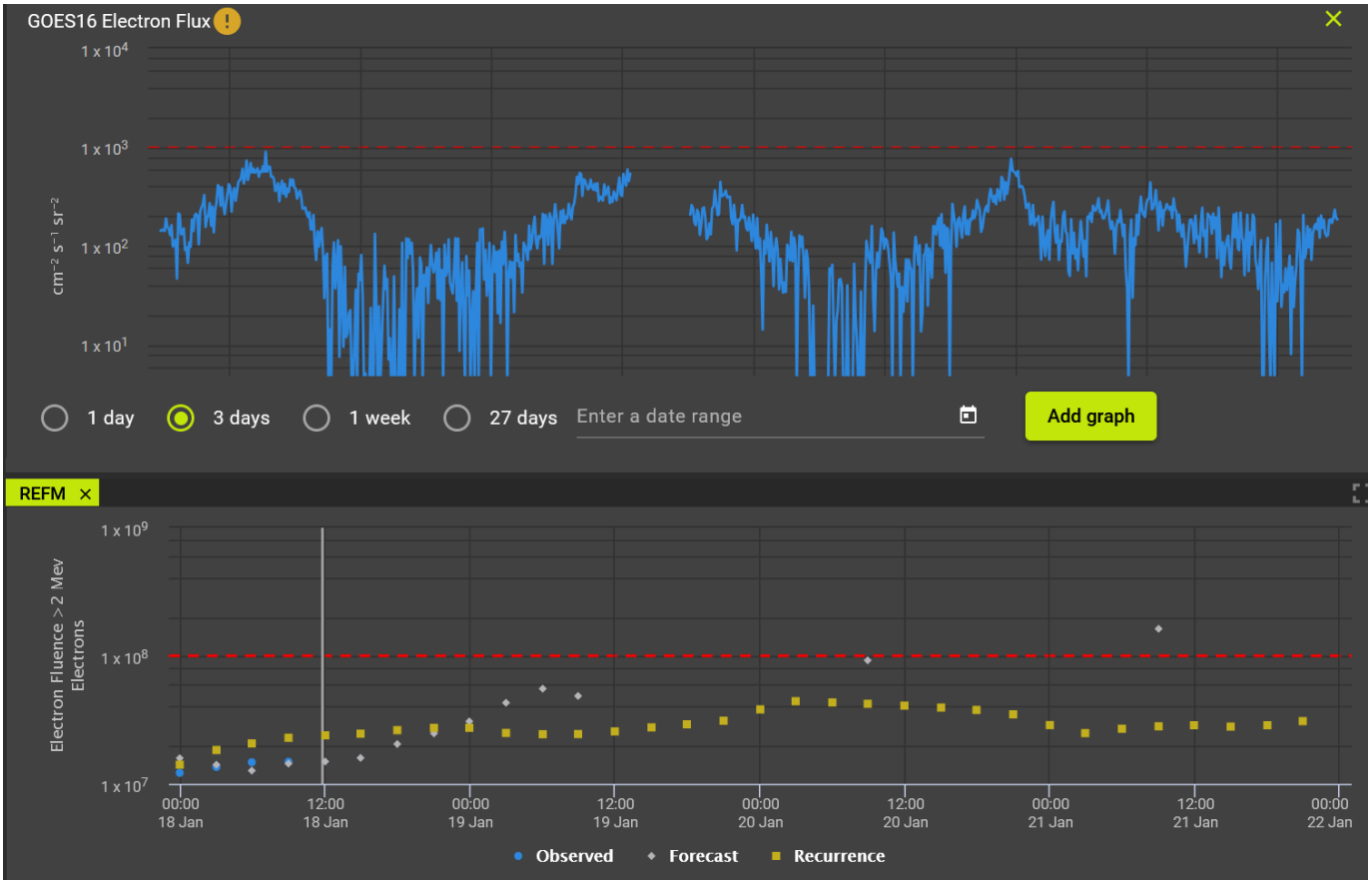
Figure 4: Latest MOSWOC REFM, showing rising trend that is accepted and may even be slightly underdone. Also shown is 27-day GOES16 electron flux and driving L1 solar wind speed. Note that High diurnal flux was reached around 25 days ago, and given the expected stronger contribution from current CH09, this may be more protracted and higher than on last pass, especially considering the forecast absence of interrupting CMEs.



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